

Serial Number: 09/800366

Dkt: H0001512 (256.087US1)

Filing Date: March 6, 2001

Title: IMPROVED BOLOMETER OPERATION USING FAST SCANNING

A complete and accurate copy of the originally submitted response dated August 29, 2002 is attached. As it appears the original response may have been damaged, Applicants request that the attached copy be used in the permanent record of this application.

Specification Objections

The Examiner objected to the amendment filed on August 29, 2002 under 35 U.S.C. 312 because it "introduces new matter into the disclosure."

Applicant has amended the specification to overcome the Examiner's objection. No new matter has been added by way of these amendments.

The specific amendments to the specification will now be discussed.

In the paragraph beginning on page 2, line 24, the language "The variation in the signal level during each bias pulse due to the temperature rise and fall can typically be many times greater than the signals caused by the incident radiation" is fully supported by the specification on page 7, lines 27-28, where it is stated that "The variation of signal level caused by this temperature variation 440 is significantly greater than the signals generated by the incident infrared radiation 130". Further, support for the above language can also be found in the specification on page 7, lines 16-20 and in FIGs. 4 and 5. FIGs. 4 and 5 clearly show in graphs 400 and 500 the temperature rise and fall 440 and 530, respectively, during each bias pulse and its effect on the signal level. In addition, in the paragraph beginning on page 2, line 7; the word "posses" has been replaced by the word "receive" and the language "dynamic range" has been replaced by "variation in signal". This amendment is fully supported by the specification for the reasons stated above.

In the paragraph beginning on page 3, line 7, the language "the minimum infrared signal that can be detected by a microbolometer is determined by the electrical noise present in the resulting current signal" is fully supported by the specification on page 3, lines 7-13, where it is stated that "The 'noise equivalent power' (NEP) of a microbolometer may be defined as the infrared radiation power change incident on a microbolometer that induces a signal current change equal to the "root mean square" (rms) current noise. The 'noise equivalent temperature difference' (NETD) is another term that is generally used in describing the performance of a

microbolometer array. The NETD is defined as the temperature change at a target that produces a signal current change in the microbolometer equal to the rms current noise."

In the paragraph beginning on page 3, line 18, the language "increases the dynamic range requirement of the circuits receiving the microbolometer signals" has been replaced by the language "requires the circuits, receiving the microbolometer signals, to receive a significantly greater variation in signal level ". This amendment is fully supported by the specification for the reasons stated above with respect to the paragraph beginning on page 2, line 24. Further, in paragraph beginning on page 3, line 18, the language "operate at a significantly lower NEP and NETD values from a microbolometer array, to improve the" is fully supported by the specification on page 3, lines 13-17, where it is stated that "In summary, the performance of the microbolometer array is generally measured in terms of the magnitudes of the NEP or NETD of the microbolometers used in the array. Generally, lower values of NEP and NETD correspond to a higher sensitivity and improved performance of the microbolometer array".

In the paragraph beginning on page 7, line 15, the language "dynamic range" has been replaced by the language "variation in signal level". This amendment is fully supported by the specification for the reasons stated above with respect to the paragraph beginning on page 2, line 24.

In the paragraph beginning on page 8, line 1, the language "shorter-duration" has been added to overcome the Examiner's objection. Further, in paragraph beginning on page 8, line 1, the word "one" has been replaced by the word "two" to overcome the Examiner's objection. This amendment is fully supported by the specification on page 4, line 3 and page 9, lines 26-28, where it is stated that "The two or more bias pulses can be substantially equally spaced in time. The two or more bias pulses can be voltage bias pulses or bias current signals. The number of the two or more bias pulses...".

In the paragraph beginning on page 8, line 8, the addition of language "two or more", and the deletion of the language "'N' fast scanning", and the deletion of the word "longer" are fully supported by the specification on page 3, lines 28-29, where it is stated that "The present invention provides a method and apparatus to apply two or more bias pulses substantially sequentially to each of the one or more microbolometers...". Further, in the paragraph beginning on page 8, line 8, the language "Because, fast scanning requires more frequent bias pulses, fast

scanning is most easily applied to small two dimensional arrays and linear arrays" has been added to overcome the Examiner's objection. This amendment is fully supported by the specification as filed on page 8, lines 12-13.

In the paragraph beginning on page 8, line 14, the language "If there are 'N' bias pulses applied within the frame time, the heating variation effect is reduced by a factor of N" is fully supported by the originally filed FIGs. 4 and 5, which shows the temperature variations 440 and 530 when applying a single bias pulse and two or more bias pulses, respectively. In addition, the amendment is fully supported by the specification on page 8, lines 15-20, which states that "It can be seen that the temperature variation of each microbolometer in the array 110 in each frame time 410 is significantly reduced by fast scanning. This is because the heating effect of shorter bias pulses is less. Also the shorter time duration 520 between the two or more bias pulses 510 allows less time for cooling to occur, also reducing the temperature variation to a lesser value 530 as shown in Figure 5".

In the paragraph beginning on page 8, line 21, the word "higher" has been replaced by the word "improved" to overcome the Examiner's objection. The amendment is fully supported by the specification on page 8 lines 17-21, which states that "Also the shorter time duration 520 between the two or more bias pulses 510 allows less time for cooling to occur, also reducing the temperature variation to a lesser value 530 as shown in Figure 5. The fast scanning method 500 shown in Figure 5 also improves array performance...".

In the paragraph beginning on page 10, line 22, the language "a measuring circuit 950" has been deleted. The language "an output circuit 950" and the language "As shown in Figure 9, ROIC 115 includes a timing circuit 920, a measuring circuit 930, and a computing circuit 940" has been added. These amendments are fully supported by the originally filed FIG. 9, which shows the output circuit 950 and the ROIC circuit 115 including the timing circuit 920, the measuring circuit 930, and the computing circuit 940.

In the paragraph beginning on page 11, line 6, the language "applied to each microbolometer in each frame time" has been added. This amendment is fully supported by the originally filed specification on page 11, lines 6-7, which states that "In some embodiments, the two or more bias pulses 510 applied to each microbolometer in each frame time are substantially equal in magnitude".

In the paragraph beginning on page 11, line 13, the language "The measuring circuit 930 can measure two or more resulting signals associated with each of the two or more bias pulses 510 and can individually control the two or more resulting signals. In some embodiments, the signal circuit can apply corrective signals to produce coarse non-uniformity correction" has been added to overcome the Examiner's objection. The proposed amendment is fully supported by the specification on page 11, lines 13-16, which states that "The signal circuit 930 is coupled to the microbolometer array 110 such that the two or more resulting signals associated with each of the two or more bias pulses 510 applied during the frame time 410 may be individually controlled. In some embodiments the signal circuit can apply corrective signals to produce coarse non-uniformity correction".

In the paragraph beginning on page 11, line 17, the amendments, adding the word "uniform" and adding the language "uniform output", are fully supported by the specification on page 10, lines 11-13, which states that "Further, the process 800 can include converting the uniform output signal value associated with each of the microbolometers of the array to a digital signal value using an integrator and an A/D converter".

In the paragraph beginning on page 17, line 6, the amendment adding language "measuring resulting current" is fully supported by the amended claim 10, which recites "...wherein the resulting signals comprise: two or more current signals". Further, in the paragraph beginning on page 17, line 6, the amendment adding the language "to improve sensitivity and performance of the array as measured by noise equivalent power and noise equivalent temperature difference" is fully supported by the specification for reasons stated above with reference to the paragraph beginning on page 3, line 18.

Claim Objections

The Examiner objected to claims 10, 15, 17, and 34 because of informalities. The Examiner also objected to claim 16 under 35 U.S.C. 1.75(c) as being of improper dependent form for failing to further limit the subject matter of a previous claim.

It is believed that the proposed amendments to claims 10, 15, 16, 17, and 34 obviate these objections. In addition, original claims 1, 4-5, 14-17, 19, and 27-31 have been voluntarily amended. No new matter has been introduced. Amendments to the claims are made to satisfy

Applicants' preferences, not necessarily to satisfy any legal requirement(s) of the patent laws, and they are not intended to limit the scope of equivalents to which any claim elements may be entitled.

The specific amendments to claims 1, 4-5, 10, 14-17, 19, 27, 29-31, and 34 will now be discussed.

In claims 1, 4-5, 14-16, 19, and 27, the language "of the microbolometers" has been replaced by the word "microbolometer". In addition, in claims 17, 29, and 30-31 the language "of the microbolometers of the array" has been replaced by the word "microbolometer".

Amendments are made to clearly recite that the two or more bias pulses are applied to each microbolometer in the array during a frame time. Support for the amendments can be found in the specification on page 8, lines 4-5, lines 14-17, and lines 21-27; page 11, lines 6-7 and lines 18-19; and page 12, line 3. Further, the amendments are fully supported for the reasons stated above with reference to the paragraph beginning on page 11, lines 6-7.

In claim 1, the language "two or more" has been added before the language "resulting signals" to provide correct antecedent. Further, in claim 1, the language "two or more" has been added before the language "bias pulses" to provide correct antecedent.

In claim 10, the word "comprise" has been replaced by the word "comprises" for grammatical clarity. Further, in claim 10 language "two or more" has been added and the word "bias" has been deleted to provide correct antecedent.

In claim 15, the word "value" has been deleted to provide correct antecedent.

In claim 16, the language "wherein the measuring circuit further comprises" has been replaced by the language "further comprising" to place the claim in proper dependent form. Support for this amendment can be found in FIG. 9, where it shows the digital image processor 340 coupled to the output circuit 950.

In claim 17, the word "processor" has been added to provide correct antecedent.

Claim 28 has been canceled.

In claim 29, the dependency has been changed from "28" to "27" to place the claim in proper dependent form. Further, in claim 29, the language "uniform output signal value" has been replaced with the language "output signal" for consistency.

In claim 31, the letter "a" has been deleted for grammatical clarity.

In claim 34, the word "bias" has been added to provide correct antecedent.

All of the above mentioned amendments to claims 1, 4-5, 10, 14-17, 19, 27, 29-31, and 34 are supported by the disclosure. Claims 1, 4-5, 10, 14-17, 19, 27, 29-31, and 34 should be found allowable over the art of record, and such action is respectfully requested.

§112 Rejection of the Claims

Claims 3-6, 15-19 and 28-32 were rejected under 35 USC § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 3-6

Proposed amendments, to the paragraphs beginning on page 10, line 22 and page 11, line 13, overcome the rejection of claim 3. The proposed amendments are fully supported by the originally filed FIG. 9 and the specification on page 10, lines 7-8, which states that "Element 840 produces an output signal based on the computed average signal value for each of the microbolometers...". Further, the amendments are supported by the specification on page 10, lines 17-20, which states that "In some embodiments, the process 800 further includes applying a corrective electrical signal to the output signal to correct for resistance non-uniformity between the one or more microbolometers in the array to obtain a uniform output signal value". Therefore, allowance of claim 3 is respectfully requested. Claims 4-6, which are dependent on claim 3, should therefore also be found to be allowable, and such action is respectfully requested.

Claim 15

Proposed amendments, of replacing the word "signal" with the word "measuring" in the paragraph beginning on page 11 and line 13 and the replacing of the word "measuring" with the word "output" in the paragraph beginning on page 11, line 17 overcomes the rejection of claim 15. These amendments are fully supported by the originally filed FIGs. 3 and 9, which show the measuring circuit 930 coupled to the output circuit 950. Further, these amendments are also

allowable for the reasons stated above with reference to claims 3-6. Therefore, allowance of claim 15 is respectfully requested.

Claims 16-19

Proposed amendment of replacing the language "wherein the measuring circuit further comprises" with the language "further comprising " to claim 16 above overcomes the rejection of claim 16. This amendment to claim 16 is fully supported by the originally filed FIG. 9, which shows the infrared radiation detector apparatus 900 including a digital image processor 340 coupled to the output circuit 950. Therefore, allowance of claim 16 is respectfully requested.

Claims 17-19, which are dependent on claim 16, should therefore also be found to be allowable, and such action is respectfully requested.

Claims 28-32

Claim 28 has been canceled. Proposed amendments to claim 29 above to correct dependency from "28" to "27" to place the claim in proper dependent form overcomes the rejection of claim 29. Therefore, allowance of claim 29 is respectfully requested. Claims 30-32, which are dependent on claim 29, should therefore also be found to be allowable, and such action is respectfully requested.

§102 Rejection of the Claims

Claims 1, 2, 7, 9-14, 20, and 22-26 were rejected under 35 USC § 102(b) as being anticipated by Wood et al. (U.S. 5,675,149) and Wood (U.S. 5,420,419).

As amended claim 14 recites "to apply two or more bias pulses substantially sequentially to each microbolometer in the array during a frame time".

Independent claim 14 is respectfully asserted to distinguish over Wood because Wood does not teach or describe each and every element of claim 14.

Wood does not disclose applying two or more bias pulses substantially sequentially to each microbolometer in the array during a frame time, as recited in amended claim 14. Wood in column 6, lines 18-34 discloses "In FIG. 6 the voltage level indicated by line 5 is that of the pulse biased current supplied to a single microbolometer in a focal plane array over time". In

FIG. 6, Wood discloses applying a single bias pulse for each microbolometer in the array that raises the temperature of the microbolometer by 2°C. Further, in FIG. 6 Wood discloses the application of a single bias pulse of 5 to 6 microseconds to a single microbolometer in a frame time including an addressing scheme of 14 pixels, i.e., 14 microbolometers at a time. Furthermore, Wood in claim 19 discloses, "sweeping the receiving units with a pulse of short duration". Thus, it can be clearly seen that Wood in column 6, lines 18-34, in FIG.6, and in claim 19 discloses applying a single bias pulse to a single microbolometer in a frame time.

In contrast, amended claim 14 recites applying two or more bias pulses substantially sequentially to each microbolometer in the array during a frame time. For this reason, independent claim 14 should thus be allowable, and such action is respectfully requested.

Claims 20 and 22-26, which are dependent from independent claim 14, should therefore also be found to be allowable, and such action is respectfully requested.

Amended independent claims 1 is respectfully asserted to distinguish over Wood for the reasons presented above. Independent claim 1 should thus be allowable, and such action is respectfully requested.

Claims 2, 7, and 9-13, which are dependent form independent claim 1, should therefore also be found to be allowable, and such action is respectfully requested.

§103 Rejection of the Claims

Claims 8, 21, 27, and 33-39 were rejected under 35 USC § 103(a) as being unpatentable over Wood et al. and Wood in view of Duvall, III (U.S. 5,258,619).

Applicant respectfully traverses the rejection of claims 8, 21, 27, and 33-39 as follows:

Amended independent claims 1, 14, and 27 are respectfully asserted to distinguish over Wood for the reasons presented above. Further, claims 8, 21, and 33-39 are respectfully asserted to distinguish over Wood and Duval references. None of these references discloses applying two or more bias pulses substantially sequentially to each microbolometer in the array during a frame time, as described in amended independent claims 1, 14, and 17. Moreover, Applicant considers additional elements and limitations of claims 1, 14, and 27 to further distinguish over the cited references, and Applicant reserves the right to present arguments to this effect at a later date.

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.116 - EXPEDITED PROCEDURE

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Applicant respectfully asserts that the Wood and Duvall references fail to support a *prima facie* case of obviousness because, as mentioned above, the cited references fail to teach or suggest all of the elements of Applicant's invention, such as applying two or more bias pulses substantially sequentially to each microbolometer in the array during a frame time.

For the above reasons, claims 8, 21, and 33-39, which depend directly or indirectly from independent claims 1, 14, and 27, respectively, should therefore be found allowable, and such action is respectfully requested.

Conclusion

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney ((603) 888-7958) to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

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CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Box AF, Commissioner of Patents, Washington, D.C. 20231, on this 21 day of January 2003.

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Signature

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